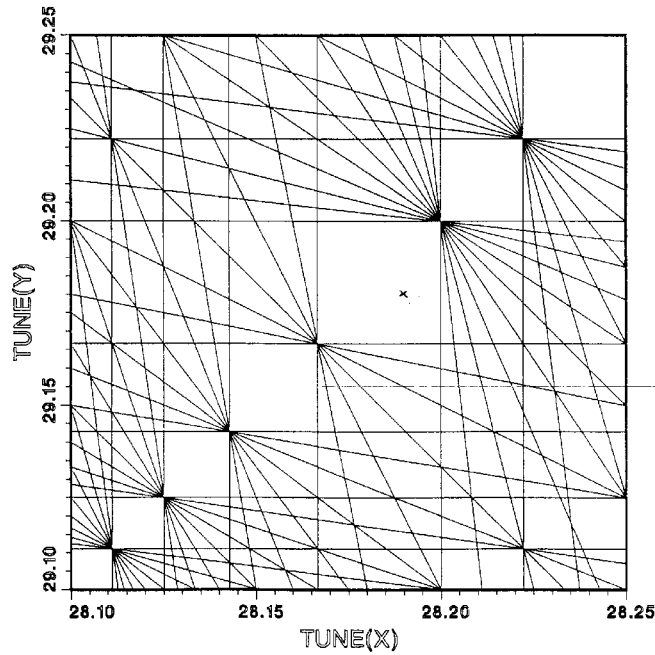


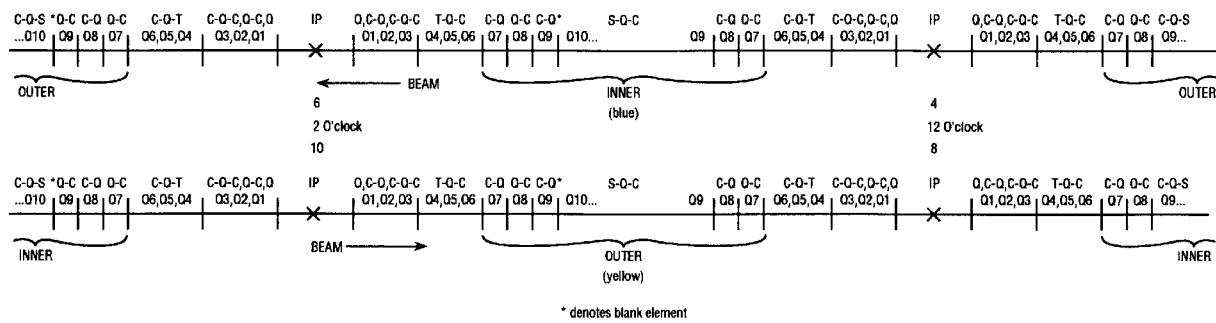
### **v. Lattice Correction Systems**

The lattice configuration described above would be completely adequate to assure stable motion of single particles assuming ideal properties of all magnet elements. Real magnets depart unavoidably from the ideal situation and will exhibit 1) systematic errors due to design or intrinsic material properties such as iron saturation or superconductor magnetization and 2) random errors due to fabrication and installation tolerances. Furthermore, the goal of high luminosity implies intense beams imposing additional operational requirements. Proper operation of the collider as built therefore requires additional systematic trim and random error correction magnets.

The primary objectives for the correction of beam optics distortions are to assure 1) that the orbit is centered in the good field aperture of the magnets and 2) that the operating tune remains in a range which is free from 10th order and lower resonances. The tune diagram for RHIC is shown in Fig. 11-15 with the selected working point at  $\nu_x = 28.19$  and  $\nu_y = 29.18$  as well as the neighboring sum resonances  $n \nu_x + m \nu_y = p$  where  $n$ ,  $m$ , and  $p$  are positive integers and  $n + m$  denotes the order of the resonance. The nominal tune is located between the 5th order systematic resonance at 28.20 and the 6th order resonance at 28.166 yielding a useable tune range of  $33 \times 10^{-3}$ . The trim/correction magnet systems for RHIC with a brief description of the beam optical purpose are listed in Table 11-4, and their ring location is shown in Fig. 11-16.



**Fig. 11-15.** Tune diagram showing the selected working point of RHIC at  $v_x = 28.19$ ,  $v_y = 29.18$  with neighboring sum and difference resonances.



**Fig. 11-16.** Ring location of trim-quadrupole T, sextupole S and corrector C magnets. Note that Q90 at 6 o'clock is a CQ (not CQ\*) assembly.

**Table 11-4.** Trim/Correction Magnet Systems Per Ring with Power Supplies on Day-One

Magnet System	Beam Optical Purpose	Units/Ring, Location, Strength
Dipole	Correct closed orbit, beam separation @ crossing point during acceleration and storage	222 $b_0/a_0$ units, 0.3 T·m each @ each QF/QD, Q4-Q9, and focussing Q2, Q3 individually powered  12 $a_0$ units/insertion, 0.3 T·m each @ defocussing Q2, Q3 individually powered
Quadrupole	$\gamma_T$ -jump  Correct $\beta_x, \beta_y, X_p$ @ crossing points and arcs	8 $b_1$ units/sextant, 1.5 T each @ QF in insertion and arc 2 families*/sextant  Trim power supplies @ Q1 - Q3, Q7, QFA, QDA Trim magnets, 21 T each @ Q4, Q5, Q6
Skew Quadrupole	Correct linear coupling and tune splitting  Correct vertical dispersion @ crossing points	8 $a_1$ units/insertion, 1.5 T each 2 families/insertion 2 $a_1$ units/insertion, 0.8 T each @ Q2, individually powered  Future option
Sextupole	Correct skew chromaticity	2 $b_2$ and 2 $a_2$ units/insertion individually powered
Octupole	Correct quadratic chromaticity  Triplet correction	15 $b_3$ units/sextant, 3.6 kT/m <sup>2</sup> each 2 F + 2 D families/sextant  4 $b_3$ units/insertion, 240 T/m <sup>2</sup> @ Q2, Q3 in low beta insertions individually powered
Decapole	Correct tune spread due to < $b_4$ > $\neq$ 0 in dipoles iron saturation  Triplet correction	Future option   2 $b_4$ units/insertion, 565 kT/m <sup>3</sup> each @ Q2, Q3 in low beta insertions individually powered
Dodecapole	Correct tune spread due to < $b_5$ > $\neq$ 0 in high-beta quads iron saturation	4 $b_5$ units/insertion, 4.9 MT/m <sup>4</sup> each @ Q2, Q3 in low beta insertions individually powered

\*A family of corrector magnets is powered by one supply.